



# UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE  
United States Patent and Trademark Office  
Address: COMMISSIONER FOR PATENTS  
P.O. Box 1450  
Alexandria, Virginia 22313-1450  
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/801,208	03/16/2004	Kwang-hee Lee	5649-1277	2034
20792 7590 04/18/2007 MYERS BIGEL SIBLEY & SAJOVEC PO BOX 37428 RALEIGH, NC 27627			EXAMINER TRAN, THANH Y	
			ART UNIT 2822	PAPER NUMBER
SHORTENED STATUTORY PERIOD OF RESPONSE		MAIL DATE	DELIVERY MODE	
3 MONTHS		04/18/2007	PAPER	

**Please find below and/or attached an Office communication concerning this application or proceeding.**

If NO period for reply is specified above, the maximum statutory period will apply and will expire 6 MONTHS from the mailing date of this communication.

# Office Action Summary

Application No.

10/801,208

Applicant(s)

LEE ET AL.

Examiner

Thanh Y. Tran

Art Unit

2822

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

## Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

## Status

- 1) ☒ Responsive to communication(s) filed on 01 February 2007.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

## Disposition of Claims

- 4) ☒ Claim(s) 1-26 is/are pending in the application.
- 4a) Of the above claim(s) 15-26 is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-14 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

## Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

## Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
  - ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

## Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO/SB/08)  
Paper No(s)/Mail Date \_\_\_\_\_
- 4) ☐ Interview Summary (PTO-413)  
Paper No(s)/Mail Date. \_\_\_\_\_
- 5) ☐ Notice of Informal Patent Application
- 6) ☐ Other: \_\_\_\_\_

**DETAILED ACTION**

***Claim Rejections - 35 USC § 103***

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

2. Claims 1-3, 9-12, and 14 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kiyotoshi et al (U.S. 2003/0017669) in view of Hong (U.S. 6,756,261).

As to claim 1, Kiyotoshi et al discloses in figures 9A-9D a method of fabricating an electrode for a microelectronic device, the method comprising: forming a ruthenium seed layer (912) (see paragraph [0016]) using atomic layer deposition on a semiconductor substrate; forming a main ruthenium layer (913) (see paragraph [0019]) on the ruthenium seed layer (912); and patterning the main ruthenium layer (913) and the ruthenium seed layer (912) to form the electrode (see figures 9B-9C).

Kiyotoshi et al does not disclose the ruthenium seed layer is formed by using atomic layer deposition.

Hong discloses in col. 3, lines 28-33 a method wherein the Ru layer is formed by using atomic layer deposition. Therefore, it would have been obvious to a person having ordinary skill in the art at the time the invention was made to modify the method of Kiyotoshi et al by using atomic layer deposition method for forming a Ru layer as taught by Hong for controlling the composition easily with excellent step coverage (col. 3, lines 28-33 in Hong).

As to claim 2, Kiyotoshi et al discloses in figures 9A-9D a method further comprising: forming a dielectric layer (107) on the electrode; and forming an upper electrode (figure 9B) on the dielectric layer to provide a capacitor (see paragraphs [0014], [0018]).

As to claim 3, Kiyotoshi et al discloses in figures 9A-9D a method further comprising: forming a storage node contact plug (108) on the semiconductor substrate and a storage node that is electrically connected to the storage node contact plug (108) to provide a semiconductor memory device, wherein the ruthenium seed layer (912) is formed on the storage node contact plug (108).

As to claim 9, Kiyotoshi et al does not disclose the ruthenium seed layer having a thickness of about 5 Å to 50 Å, and the main ruthenium layer having a thickness of 50 Å to 300 Å. However, the thickness range for a layer would have been obvious to an ordinary artisan practicing the invention because, absent evidence of disclosure of criticality for the range giving unexpected results, it is not inventive to discover optimal or workable ranges by routine experimentation. In re Aller, 220 F.2d 454, 105 USPQ 233, 235 (CCPA 1955). Furthermore, the specification contains no disclosure of either the critical nature of the claimed dimensions of any unexpected results arising therefrom. Where patentability is aid to be based upon particular chosen dimensions or upon another variable recited in a claim, the Applicant must show that the chosen dimensions are critical. See In re Woodruff, 919 F.2d 1575, 1578, 16 USPQ2d 1934, 1936 (Fed. Cir. 1990).

As to claim 10, Kiyotoshi et al in view of Hong does not disclose supplying oxygen at a flow rate of about 1 sccm to 50 sccm for forming of the main ruthenium layer; and supplying a ruthenium source at a flow rate of about 0.1 ccm to 2 ccm under a pressure of about 0.4 Torr to

0.6 Torr. However, a flow rate of supplying oxygen of about 1 sccm to 50 sccm, or a flow rate of a ruthenium source about 0.1 ccm to 2 ccm under a pressure of about 0.4 Torr to 0.6 Torr would have been obvious to an ordinary artisan practicing the invention because, absent evidence of disclosure of criticality for the range giving unexpected results, it is not inventive to discover optimal or workable ranges by routine experimentation. In re Aller, 220 F.2d 454, 105 USPQ 233, 235 (CCPA 1955). Furthermore, the specification contains no disclosure of either the critical nature of the claimed dimensions of any unexpected results arising therefrom. Where patentability is aid to be based upon particular chosen dimensions or upon another variable recited in a claim, the Applicant must show that the chosen dimensions are critical. See In re Woodruff, 919 F.2d 1575, 1578, 16 USPQ2d 1934, 1936 (Fed. Cir. 1990).

As to claim 11, Kiyotoshi et al in view of Hong does not disclose the dielectric layer comprises a tantalum oxide layer. However, it would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the method of Kiyotoshi et al by using a tantalum oxide material for a dielectric layer for providing a suitable high-k material for the dielectric layer, since it has been held to be within the general skill of a worker in the art to select a known material on the basis of its suitability for the intended used as a matter of obvious design choice. In re Leshin, 125 USPQ 416.

As to claim 12, figure 9C of Kiyotoshi et al discloses a method comprising: forming a second Ru seed layer (912) on the dielectric layer (107); and forming a second main Ru layer (913) on the second Ru seed layer (912).

Kiyotoshi et al does not disclose the ruthenium seed layer is formed by using atomic layer deposition.

Hong discloses in col. 3, lines 28-33 a method wherein the Ru layer is formed by using atomic layer deposition. Therefore, it would have been obvious to a person having ordinary skill in the art at the time the invention was made to modify the method of Kiyotoshi et al by using atomic layer deposition method for forming a Ru layer as taught by Hong for controlling the composition easily with excellent step coverage (col. 3, lines 28-33 in Hong).

As to claim 14, Kiyotoshi et al in view of Hong does not disclose the ruthenium seed layer has an oxygen concentration of less than 5%. However, a ruthenium seed layer has an oxygen concentration of less than 5% (for forming an electroless depositing layer (ruthenium seed layer)) would have been obvious to an ordinary artisan practicing the invention because, absent evidence of disclosure of criticality for the range giving unexpected results, it is not inventive to discover optimal or workable ranges by routine experimentation. In re Aller, 220 F.2d 454, 105 USPQ 233, 235 (CCPA 1955). Furthermore, the specification contains no disclosure of either the critical nature of the claimed dimensions of any unexpected results arising therefrom. Where patentability is aid to be based upon particular chosen dimensions or upon another variable recited in a claim, the Applicant must show that the chosen dimensions are critical. See In re Woodruff, 919 F.2d 1575, 1578, 16 USPQ2d 1934, 1936 (Fed. Cir. 1990).

3. Claims 4-6, and 7-8 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kiyotoshi et al (U.S. 2003/0017669) in view of Hong (U.S. 6,756,261) as applied to claim 1 above, and further in view of Aaltonen et al (U.S. 2005/0020060).

As to claims 4-6, Kiyotoshi et al in view of Hong does not disclose the steps of forming the ruthenium seed layer using atomic layer deposition comprises: injecting a ruthenium source

into a chamber containing the semiconductor substrate; then injecting an O.sub.2-containing gas into the chamber containing the semiconductor substrate; and then injecting an H.sub.2-containing gas into the chamber containing the semiconductor substrate; purging the chamber following the injection of the ruthenium source, the injection of the O.sub.2-containing gas, and the injection of the H.sub.2-containing gas; and wherein the O.sub.2-containing gas comprises an O.sub.2 gas.

Aaltonen et al discloses the steps of forming the ruthenium seed layer ("ruthenium") using atomic layer deposition ("ALD") (see paragraph [0016]) comprises: injecting a ruthenium source ("ruthenium") into a chamber containing the semiconductor substrate (see paragraphs [0016]-[0018]); then injecting an O.sub.2-containing gas ("oxygen" gas or "H.sub.2.O.sub.2" gas that contains O<sub>2</sub> gas) into the chamber containing the semiconductor substrate (see paragraph [0056] & [0039]); and then injecting an H.sub.2-containing gas ("H.sub.2.O.sub.2" gas that contains H<sub>2</sub> gas) into the chamber containing the semiconductor substrate (see paragraph [0056]); and purging the chamber following the injection of the ruthenium source, the injection of the O.sub.2-containing gas ("oxygen containing gas", or "H.sub.2.O.sub.2" gas that contains O<sub>2</sub> gas), and the injection of the H.sub.2-containing gas (H.sub.2.O.sub.2" gas that contains H<sub>2</sub> gas) (see paragraphs [0040]-[0041], [0056], [0076], [0079], and [0102]); and wherein the O.sub.2-containing gas comprises an O.sub.2 gas ("H.sub.2.O.sub.2" gas that contains O<sub>2</sub> gas, (see paragraph [0056])). Therefore, it would have been obvious to a person having ordinary skill in the art at the time the invention was made to modify the method of Kiyotoshi et al in view of Hong by having the steps of: injecting a ruthenium source, O.sub.2-containing gas, and H.sub.2-containing gas into the chamber containing the semiconductor substrate; purging the chamber

following the injection of the ruthenium source, the injection of the O.sub.2-containing gas, and the injection of the H.sub.2-containing gas; and wherein the O.sub.2-containing gas comprises an O.sub.2 gas as taught by Aaltonen et al in order to control the surface reactions of the precursor chemicals, or avoid gas phase reactions (see paragraph [0034] in Aaltonen et al).

As to claim 7, Kiyotoshi et al discloses in figures 9A-9D a method wherein at least one of the O.sub.2-containing gas is supplied in a plasma phase (see paragraph [0127]).

As to claim 8, Kiyotoshi et al in view of Hong does not disclose the steps of: injecting the ruthenium source, injecting the O.sub.2-containing gas, and injecting the H.sub.2-containing gas into the chamber is performed at least twice until the ruthenium seed layer is grown to a desired thickness.

Aaltonen et al discloses the steps of: injecting the ruthenium source (see paragraphs [0016]-[0018])), injecting the O.sub.2-containing gas ("H.sub.2.O.sub.2" gas that contains O<sub>2</sub> gas, see [0056]), and injecting the H.sub.2-containing gas ("H.sub.2.O.sub.2" gas that contains H<sub>2</sub> gas, see [0056]) into the chamber is performed at least twice until the ruthenium seed layer is grown to a desired thickness (see [0034], [0020], & [0041]). Therefore, it would have been obvious to a person having ordinary skill in the art at the time the invention was made to modify the method of Kiyotoshi et al in view of Hong by injecting the gases into the chamber is performed at least twice ("repeating") until the ruthenium seed layer is grown to a desired thickness as taught by Aaltonen et al for obtaining a desired thickness for the depositing thin film (ruthenium thin film) (see paragraphs [0034], [0020], & [0041] in Aaltonen et al).

4. Claim 13 is rejected under 35 U.S.C. 103(a) as being unpatentable over Kiyotoshi et al (U.S. 2003/0017669) in view of Hong (U.S. 6,756,261) as applied to claim 1 above, and further in view of Pakr (U.S. 6,656,784).

As to claim 13, Kiyotoshi et al in view of Hong does not disclose the main ruthenium layer is formed using chemical vapor deposition.

Pakr discloses in figure 3C a method wherein the main ruthenium layer (42) is formed using chemical vapor deposition (see col. 5, lines 15-20). Therefore, it would have been obvious to a person having ordinary skill in the art at the time the invention was made to modify the method of Kiyotoshi et al in view of Hong by use chemical vapor deposition for forming the main ruthenium layer as taught by Pakr for producing high-quality depositing layer.

#### ***Response to Arguments***

5. Applicant's arguments with respect to claims 1-14 have been considered but are moot in view of the new ground(s) of rejection.

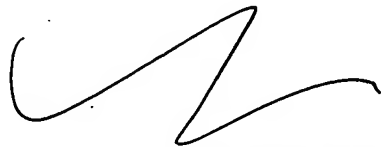
#### **Contact Information**

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Thanh Y. Tran whose telephone number is (571) 272-2110. The examiner can normally be reached on M-F (9-6:30pm).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Zandra Smith, can be reached on 571-272-2429. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

TYT

A handwritten signature in black ink, consisting of a large, stylized 'M' followed by a horizontal line and a small upward stroke.

**Mary Wilczewski**  
**Primary Examiner**